EARTHQUAKE ENGINEERING AND STRUCTURAL DYNAMICS, VOL. 26, 301–303 (1997)

BOOK REVIEW

PROCEEDINGS OF THE 10TH EUROPEAN CONFERENCE ON EARTHQUAKE ENGINEERING, Vols. 1–4, edited by Gerald Duma, A. A. Balkema, Rotterdam, 1995. No. of pages: 3150. Price: UK£ 245 (per set). Set of four volumes: ISBN 90 5410 528 3; Vol. 1: ISBN 90 5410 529 1; Vol. 2: ISBN 90 5410 530 5; Vol. 3: ISBN 90 5410 531 3; Vol. 4: ISBN 90 5410 532 1.

The large earthquake engineering conferences in the English language (World, U.S. National and European), which are held every four years, are of major importance, but as their proceedings contain from several hundred to over a thousand papers, they are not suitable for an overall review. This reviewer made this point when reviewing a considerably smaller conference, Earthquake Resistant Construction and Design, 2nd Conf. (*Earthquake eng. struct. dyn.* **24**, 462–464 (1995)), which included only 144 papers, but nevertheless the review had to be selective. However, the comment was made there that a review of one of the major conferences was feasible if attention was confined to opening addresses and keynote lectures. In reviewing the 10th European Conference on Earthquake Engineering (10ECEE) a somewhat wider interpretation of 'selective' will be made by including state-of-the-art and review lectures.

This conference was held at the Technical University in Vienna, Austria, from 28 August to 2 September 1994. From the preface about 600 participants attended the conference and 550 contributions were presented as state-of-the-art reports, regular lectures or poster presentations. The proceedings include all presented papers, which were submitted and accepted for publication.

The published proceedings are arranged into 18 sections with the first section containing the plenary address and the keynote lecture, 15 sections on different subjects, a section containing papers on each of 14 special themes and a final section giving reports from some of the working groups of the European Association for Earthquake Engineering (EAEE). This leads to over 450 contributions from over 40 countries. Italy provides the largest number of contributions with approximately 20 per cent of the total; France, U.S.A., Greece and U.K. each supply between 5 and 10 per cent.

H. C. Shah and T. Katayama gave the plenary address, 'WSSI – a dream, a challenge and a time for action'. The concept of the United Nations' International Decade for Natural Disaster Reduction (IDNDR) is described. The involvement of the IAEE is reviewed with emphasis on its establishement of the World Scientific Safety Initiative (WSSI). Its goals, organization and activities are described with emphasis on the various meetings, which have been arranged by WSSI. The importance of increasing public and governmental awareness is stressed. Future activities are outlined.

The keynote lecture, 'Capacity design and nonlinear dynamic analysis of earthquake-resistant structures', was given by H. Bachmann, P. Linde and T. Wenk. The application of capacity design principles leads to tolerable inelastic response and a high degree of protection against the collapse of structures which are subjected to severe earthquakes. The main advantages of capacity design are: Plastic deformations will occur in predetermined locations only; rational and suitable mechanisms for energy dissipation are established; a hierarchy of strength within the system is clearly defined; locations within the structure, where special detailing for ductility is required, are established uniquely; local ductility demands can be related better to the global ductility demand; and it allows an economical solution to be obtained. The major requirements for a non-linear dynamic computer program are: Finite-element based non-linear dynamic solver; elements with suitable hysteretic constitutive laws; efficient graphical pre-and post-processors; availability of 2-D analysis and 3-D analysis. For RC frames beam, beam-column and fibre models are used; for RC structural walls beam, truss, macro and micro models are used. In the program ABAQUS/QUAKE user elements for plastic regions are implemented. The verification of the numerical models with experimental data is of major importance for non-linear dynamic computer codes.

In most of the 15 sections, where relatively short papers on the various major topics of earthquake engineering are presented, there is at least one state-of-the-art, review or overview paper. Authors use one of these three descriptions, usually in the title, but sometimes only in the summary, and there does not seem to be any differentiation between them. As papers are published consecutively within a section in the order in which they were given at the conference, a state-of-the-art paper can be found at any location within a list of up to 60 papers. In the section, 'Strong ground motion and site effects', M. D. Trifunac and E. I. Novikova review recent developments in the empirical scaling and analysis of the duration of this motion. After stressing its importance, definitions of duration are reviewed with emphasis on that used in the most recent studies, (namely, duration is related to the rate of energy input into structures). The influence on duration of the physical parameters of the source and

propagation path and regional geological and local soil characteristics are discussed. Finally, scaling models, which have been obtained by regression analyses of strong motion recordings in the western U.S.A., are presented. In the same section P.-Y. Bard reviews recent results for the effects of surface geology on ground motion. Instrumental as well as numerical approaches are considered; their advantages and limitations are discussed. Recent knowledge on the physics of site effects concerns mainly the importance of wave diffraction on near surface irregularities and of the non-linear behaviour of soft deposits under strong shaking. Attention is drawn to the lack of dense arrays, which are dedicated to investigating site effects, in Europe.

B. O. Skipp reviews the acquisition, choice and use of ground parameters, which are needed to perform soil–structure interaction (SSI) analyses. Current techniques and assessment of the validity of the information are described . The uncertainties inherent in attempting to characterize ground parameters and the effects of these uncertainties on the resulting impedances in SSI analyses are outlined. S. A. Savidis and C. Vrettos describe the state-of-the-art when performing SSI analyses for foundations, which rest on non-homogeneous soils. Methods of determining impedance functions are described. The authors conclude that the developed methods tend to overestimate the variation of properties with depth when compared to practical situations. Also for real conditions both vertical and horizontal inhomogeneity should be considered, but this is very difficult analytically.

I. Olariu describes the many different types of passive control and base isolation for the reduction of seismic response. Their effectiveness, advantages and disadvantages and the developments which are required for future improvement are all summarized. In the section, 'Interpretation of damage in recent earthquakes', A. Corsanego describes recent trends and concludes that an interdisciplinary approach to the four factors, which control damage, namely seismic intensity, seismic vulnerability, site phenomena and human error, is essential in order to obtain the maximum amount of relevant information. In lessons learnt from past earthquakes M.N. Fardis describes the behaviour of reinforced concrete and unreinforced masonry buildings, which have low earthquake resistance, during four recent Greek earthquakes. The importance of local soil effects in the near field is assessed. The difference in the behaviour of these buildings, compared to that of prefabricated buildings in the Armenia 1988 earthquake, is emphasized.

In a state-of-the-art lecture on the design philosophy of the 'concrete' section of European Code No. 8 (EC8) T. P. Tassios describes first the scope, drafting process and features of a regional code and then gives the structural requirements and related design criteria to satisfy the requirements of the code. S. A. Anagnostopoulos discusses the problem of earthquake induced pounding between adjacent buildings in the context of the available field observations from past earthquakes, reviews published work and summarizes the main conclusions. Finally he suggests new measures for the protection of structures from pounding as an alternative to those contained in seismic codes. While his state-of-the-art lecture is included in the section, 'Seismic design methodology', the other papers on pounding ('Seismic pounding of adjacent single storey symmetric structures' by E. Leibovich, A. Rutenberg and D. Z. Yankelevsky and 'Influence of soil–structure interaction on pounding between buildings during earthquakes' by N. Chouw and and G. Schmid) are in sections on 'Methods of analysis and design' and 'Soil–structure interaction' respectively. This illustrates the interaction between topics and the difficulties of locating a distinct subject — even one such as pounding which is represented by a very small number of papers — within a single section.

A. Pecker reviews the seismic design of shallow foundations. Significant studies towards a more rational analysis of their bearing capacity have been undertaken recently, following the observed failures in Mexico City during the 1985 Michoacan earthquake. The practice which assumes uncoupling between the evaluation of the dynamic loads acting on the foundation and the verification of the bearing capacity is examined. The author comments on recent improvements and finally gives a definition of dynamic bearing capacity 'failure' and proposes a method for its evaluation. However, these concepts are still being developed and need further research and comparison with actual behaviour.

P. Fajfar gives an overview of the most common, and also some recently developed, procedures for the determination of elastic and inelastic design spectra. The majority are restricted to acceleration spectra, which, in simplified forms, are included in seismic codes. The recently developed displacement, input energy and hysteretic energy spectra are discussed.

The importance of non-structural elements in seismic design and performance evaluation is now well-known. In his state-of-the-art report T. T. Soong gives some important examples from recent earthquakes, summarizes research on the seismic behaviour of non-structural elements and indicates the current state of engineering practice. In a related review P. Sollogoub considers the seismic design of equipment in buildings and in industrial facilities and stresses the importance of providing protection from the points of view of safety and economic issues and of eliminating failures in equipment associated with lifelines.

C. Nuti and G. Monti review seismic analysis of bridges, excluding long-span structures. A survey of damage in past earthquakes, a review of codes, details of analytical models and specific treatment of major components and also foundations and SSI are included. Recent trends on non-synchronism in seismic input and its effect on structural response are discussed. R. G. Flesch and A. Klatzer report on the earthquake resistant design of RC bridges. Simple procedures are outlined with guidelines on the limits of their applicability. Sensitivity investigations help to assess uncertainties in assumed properties; the influence of local variations of stiffness, damping ratio and regularity are considered. M. Wieland gives a state-of-the-art report on earthquake safety assessment in large concrete arch dams, which is based on case studies of dams in a seismically moderate region of

Switzerland and in highly active regions of Iran. The methodology for safety assessment and the structural modelling are described. Results from a linear dynamic analysis of the dam–reservoir–foundation system are used to evaluate safety, assuming a massless foundation and incompressible behaviour of the reservoir. High dynamic tensile stresses are found in the upper portion of the dam, but it is shown that the large arch dams analysed will perform satisfactorily during the maximum credible earthquake, which has peak accelerations of the order of 0·5 g for the Iranian dams. Finally, the cracking of the Sefid Rud buttress dam, which was caused by the 7·6 Manjil earthquake of 1990, and the resulting remedial measures are described. Lastly in this long section 'Analysis and design of special structures and industrial facilities' (containing 59 papers), J. M. Kelly reviews the development of isolators and their components for earthquake resistant design. A rapidly increasing number of buildings, both new constructions and retrofit, are using isolators to reduce the effects of seismic forces on contents and equipment and thus give a better performance than a conventional fixed-base building in moderate or strong earthquakes. Applications in U.S.A., Japan, New Zealand and Italy are described. The 1994 Northbridge earthquake has provided examples of the response of base-isolated buildings to strong ground motion with highly favourable results, which should encourage further applications.

In the section, 'Lifeline systems', M. J. O'Rourke gives a state-of-the-art review of the seismic behaviour of buried pipeline components. It covers major contributions to knowledge over the past 10 years, as well as a summary of the author's 1985 review. Included topics are seismic hazards, failure criteria, past performance, wave propagation, fault crossing behaviour, and permanent ground deformation. D. Aničić reviews the repair and retrofit of building structures. He considers the need to install proper protection against seismic action in buildings, emphasizing the large number of casualties from past earthquakes, the increasing risk as the population grows in seismically active regions and the vast number of buildings, which were constructed before any codes of practice existed. He discusses which types of building should be strengthened or reconstructed and then describes technical procedures for strengthening masonry and RC buildings. In the last general section, 'Experiments and tests', G. Bonacina, F. Bettinali and A. Martelli describe the state-of-the-art of the work in progress on the seismic isolation of structures, with particular reference to the large numbers of bridges, viaducts, public buildings and industrial facilities in Italy, where isolators have been, or are being, installed. The authors describe model tests in the laboratory, in-situ tests of actual buildings and numerical analysis of isolated structures.

Section 17, 'Special themes', contains 74 papers, illustrating the 14 varied themes. Some may be regarded as direct extensions of material, which has been included in earlier volumes; for example, there are 8 papers on 'Active control', whereas there are many papers on various aspects of passive control in earlier sections. Other topics, for example, 'Recent advances in earthquake engineering and structural dynamics' and 'Non-linear analysis', might be expected to be represented by contributions in earlier sections. The last theme, 'ECOEST — The European Consortium of Earthquake Shaking Tables', gives more information on this topic of considerable practical importance than is usual in major conferences. In an overview R. T. Severn considers initially the shaking table facilities in laboratories at Athens, Bergamo, Bristol and Lisbon. P. G. Carydis, H. P. Mouzakis, E. A. Vougioukas, C. A. Taylor and A. J. Crewe describe the preliminary results of a comparative study of the performance of the two six degree-of-freedom shaking tables at the National Technical University of Athens and at Bristol University. Noting the word 'preliminary' above, it should be mentioned that a further comparison, which includes also the shaking tables at Bergamo and Lisbon, was presented at the 11th World Conference on Earthquake Engineering (11WCEE) at Acapulco in 1996. Details of the new shaking table at LNEC, Lisbon, are given by R. T. Duarte, A. Campos-Costa and C. T. Vaz. Also M. Casirati and G. Franchioni describe the design and planned tests for a 1 : 8 model of an irregular bridge to be tested with three piers on three shaking tables at Bergamo; again there is further information on these tests in the Proceedings of 11WCEE. However, the most comprehensive comparison of the characteristics of European shaking tables of various sizes and numbers of degrees of freedom in 11 countries is included in one of the EAEE Working Group Reports (Section 18) by R. T. Duarte. He gives also comparable information, but restricted to some large shaking tables, defined as having a table area of at least 16 m^2, in other countries, mainly Japan, but the latter list is not claimed to be comprehensive.

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